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National Ocean Service
Center for Coastal Fisheries and Habitat Research
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Characterization of the Tortugas Ecological Reserve (TER): seafloor surveys and oceanographic processes

August 27, 2002

Cruise and Progress Report for Leg I of
NOAA Ship Ferrel Cruise FE-02-15-FK
15 July – 19 July, 2002

Submitted By:

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INTRODUCTION

The central research theme in our laboratory has been how the structure and function of benthic ecosystems such as coral reefs, seagrasses, and algal beds, are modified by human behavior. Human behavior can cause specific injuries to a resource, including vessel groundings, anchor damage, and other gear impacts. In addition, human behavior indirectly affects benthic systems by fundamentally altering the surrounding environment. Indirect effects can be perceived as negative (e.g., eutrophication) or positive (the establishment of marine protected areas).

The implementation of the Tortugas Ecological Reserve (TER) in July 2001 has provided an excellent opportunity for NOAA to investigate the effect of human disturbance in the Tortugas. Consumptive sampling and physical impacts were eliminated within the boundaries of the Reserve; by conducting preliminary habitat characterization and subsequently monitoring core sites, we can document changes in community structure that are correlated with resource protection. We can also use certain habitat characterization tools (e.g. fluorescence surveys and coral settlement arrays) to focus on the dynamics of small organisms, which can be a key indication of reef health.

In support of this research, the NOAA Ship Ferrel arrived in Key West, FL on 15 July 2002 to support research objectives of the CCFHR and collaborators (CCMA, CSC, FMRI, NURC, USF) in the Tortugas Ecological Reserve. A total of seven scientists representing four federal and state institutions participated on this leg, which was the ninth cruise in support of this mission.

OBJECTIVES

Programmatic: Over the past three years, our coral reef research in the Tortugas and the Florida Keys has proposed:
1) a preliminary characterization and inventory of the benthic habitat and fish communities in the extreme depths of the Tortugas South reserve component;
2) the characterization of spawning aggregations and initiating the development of a probabilistic model of the fate of snapper larvae, focusing on Riley's Hump;
3) a beginning comparative characterization of shallow and deepwater seagrass and coral communities and their contribution to fishery resources in disturbed (outside the TER) and undisturbed sites (inside the TER);
4) the establishment of a baseline for benthic nutrient composition and flux in disturbed and undisturbed sites;
5) a determination of the accuracy of existing habitat delineations within the TER as a function of depth and disturbed and undisturbed sites;
6) an examination of how high-resolution ecological data of a given habitat type can be scaled to the larger spatial context of the TER;
7) the development of spatially explicit recovery models for seagrasses and coral reefs, that meet Daubert standards and can be used in litigation to recover damages for vessel groundings;
8) calibration of these models via habitat characterization for injury sites of known age;

9) the use of coral fluorescence to identify and enumerate juvenile corals and new recruits for injury assessment and habitat characterization.

Cruise FE-02-15-FK: Here, our objectives were to:
1) Complete any habitat characterizations, sidescan sonar, coral recruitment installations, and any other work in the Tortugas not completed during FE-02-14-BL, Legs I-III.
2) Return to a selected subset of the 30 permanent stations (Figure 1, Appendix I), and stations within Monument (East Tortugas) Banks to conduct ship-based observations of coral night-time fluorescence and diver video/still photography of coral fluorescence, requiring paired day/night dives.

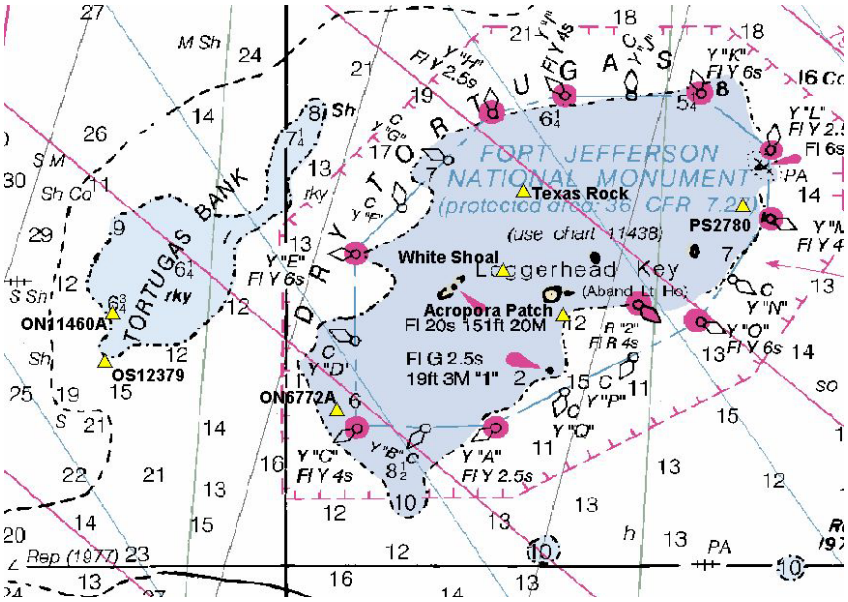

Figure 1. Sampling stations for FE-02-15-FK.

3) Continue from previous cruises a ground-truthing project for aerial photography using drop cameras around Dry Tortugas National Park (DTNP).
4) Service temperature loggers installed during the April 2002 cruise (Figure 2), or loggers installed by the Florida Marine Research Institute during May 2002.

Figure 2. Temperature logger on rebar stake at a CCFHR permanent station.

Cruise Component: 15 July 2002 Departed Key West, FL
19 July 2002 Arrived Key West, FL

-video and sonar mapping along defined transects using Sport Scan sidescan sonar and towed video; at selected sites, deployed divers to record night-time coral fluorescence

observations using still and video photography; conducted ground-truthing for aerial photography using drop cameras

Participants:

Name	*Title*	*Affiliation*
Greg Piniak	Chief Scientist	NOS, Beaufort, NC
Christine Addison	Field Party Chief	NOS, Beaufort, NC
Don Field	Geographer	NOS, Beaufort, NC
Christopher Slade	Biological Technician	NOS, Beaufort, NC
Shay Viehman	Associate Science Coordinator	Biscayne National Park
Will Figueira	Ph.D. Student	Duke University Marine Lab
Ruth Kelty	Ecologist	NCCOS, Silver Spring, MD

TORTUGAS ECOLOGICAL RESERVE (NORTH)

Station Location and General Survey Work: Benthic mapping at selected stations was conducted using the Sport Scan sidescan sonar system. Sonar transects along the southwest portion of the Monument Bank were verified using MiniBAT equipped with a downward looking video camera. Divers were deployed at selected stations to observe coral fluorescence, and to record these observations with still and video photography. Divers were also deployed to service temperature loggers deployed during previous field work. Random points from the area around DTNP were selected for drop camera verification of substrate as a means of ground-truthing aerial photography. A complete list of sampling activities is presented in Appendix II.

Approach (Specific): We had unexpected access to this ship time, and used it to supplement our ongoing research in the Tortugas, which is based on stratified sampling of 30 permanent stations in TER, in DTNP, and in unprotected areas. We used this cruise to investigate unmapped areas, to conduct additional activities at selected permanent stations, and to investigate coral fluorescence (Figure 3).

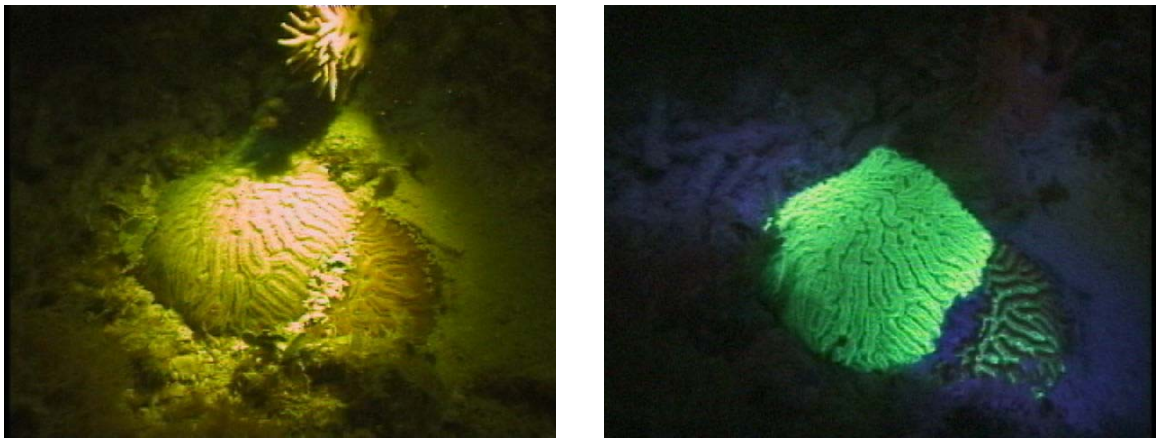

Figure 3. Coral fluorescence. The image on the left is a white-light picture of adjacent coral colonies; the picture on the right is a fluorescent image of the same two colonies.

***Diving*:** The main objective of diving operations was to observe coral fluorescence (Figure 3). During the day, divers visited selected stations and laid out transect lines to prepare the site for the survey. Divers returned to the site at night and used equipment from Night Sea to observe coral fluorescence. In addition to visual observations, divers recorded images of corals and other fluorescent reef organisms using both still and video photography. Dives were also conducted to service temperature loggers and to collect stable isotope samples of coral reef fish. We logged 47 dives during this cruise; dive statistics are listed in Appendix IV.

***Sport Scan Sidescan Sonar*:** We began mapping our 30 permanent stations with sidescan sonar in April 2002 on FE-02-10-BL. During FE-02-15-FK, we used the unit to investigate unmapped areas in the southwest portion of Monument Banks. We also conducted additional surveys at two of our permanent stations (OS12379 and PS2780), and mapped two new stations (ON6772A and ON11460A) that were established as coral recruitment sites during FE-02-13-BL.

***Video Tows and Drifts*:** We used three different techniques to record video images of the seafloor: drop camera drifts, ROV drifts, and MiniBAT tows. All three instrument packages were modified with Night Sea equipment in an attempt to observe coral fluorescence using remote platforms. MiniBAT was also used to verify sidescan images.

Results and Implications: While the sidescan sonar and ground-truthing data from this cruise represent a valuable addition to our mapping efforts during FE-02-14-BL, Legs I-III, the majority of the time on this cruise was devoted to the development of fluorescent technologies as a coral reef survey tool. During this cruise we tested coral fluorescence using five platforms: drop camera, ROV, towed MiniBAT video, diver video, and diver still photography. Ship-based platforms proved difficult to work with; problems with light delivery and fast platform movement limited our observations to large coral colonies only. However, divers successfully used video and still photography to obtain fluorescence images of a wide variety of organisms (algae, corals, anemones, fish, crabs), including objects several millimeters in size. Because it has proven useful in locating and identifying very small reef organisms, fluorescence has the potential to provide estimates of coral recruitment rates that are less time-consuming and labor-intensive than conventional methodologies. This approach would provide a rapid, simple estimate of reef health that could be used for routine monitoring and restoration applications.

APPENDIX I. Survey stations.

Station ID	***Latitude***	***Longitude***	***Depth (ft)***
OS12379	24.598416667	83.08708333	103
PS2780	24.673361295	82.780903483	54
ON11460A	24.621503861	83.083558803	55
ON6772A	24.575523908	82.975826700	55
Acropora patch	24.620716667	82.867333333	12
Texas Rock	24.6801670	82.8863300	61
White Shoal	24.6423300	82.8968330	47

APPENDIX II. Sample log.

Date	*Start Time*	*Station*	*Strata*	*Sample Code*	*Latitude*	*Longitude*
7/15/02	1611 EST	Texas Rock		DIVE	24.680167	82.88633
7/15/02	1559 EST	Texas Rock		DIVE	24.680167	82.88633
7/15/02	1734 EST	Texas Rock		DIVE	24.680167	82.88633
7/15/02	2310 UTC	NW channel		BAT		
7/15/02	2310 UTC	NW channel		SVHS/DV		
7/15/02	2310 UTC	NW channel		ASP	24.675022	82.87806023
7/15/02	2115 EST	Texas Rock		DIVE	24.680167	82.88633
7/15/02	2101 EST	Texas Rock		DIVE	24.680167	82.88633
7/15/02	0301 UTC	NW channel		BAT		
7/15/02	0301 UTC	NW channel		SVHS/DV		
7/16/02	0301 UTC	NW channel		ASP	24.68133406	82.87769387
7/16/02	0322 UTC	NW channel		BAT		
7/16/02	0322 UTC	NW channel		SVHS/DV		
7/16/02	0322 UTC	NW channel		ASP	24.68648282	82.86677296
7/16/02	0518 UTC	Monument Bank		BAT	24.55879874	82.94706852
7/16/02	0518 UTC	Monument Bank		SVHS/DV	24.55879874	82.94706852
7/16/02	0518 UTC	Monument Bank		ASP	24.55879874	82.94706852
7/16/02	0830 EST	Monument Bank		TRUTH		
7/16/02	1317 UTC	Monument Bank		SPORT	24.55593333	82.943
7/16/02	1409 UTC	Monument Bank		SPORT	24.56405	82.9644
7/16/02		Monument Bank				
7/16/02	1632 UTC	Monument Bank		BAT	24.56415931	82.96398421
7/16/02	1632 UTC	Monument Bank		SVHS/DV	24.56415931	82.96398421
7/16/02	1632 UTC	Monument Bank		ASP	24.56415931	82.96398421
7/16/02	1759 UTC	6772A	ON	SPORT	24.5716667	82.97638333
7/16/02	1842 UTC	6772A	ON	SPORT	24.58051667	82.97553333
7/16/02	1544 EST	6772A	ON	DIVE	24.5755666	82.9759666
7/16/02	1553 EST	6772A	ON	DIVE	24.5755666	82.9759666
7/16/02	1733 EST	6772A	ON	DIVE	24.5755666	82.9759666
7/16/02	1733 EST	6772A	ON	SI_FISH	24.5755666	82.9759666
7/16/02	1733 EST	6772A	ON	SI_FISH	24.5755666	82.9759666
7/16/02	1733 EST	6772A	ON	SI_FISH	24.5755666	82.9759666
7/16/02	1733 EST	6772A	ON	SI_FISH	24.5755666	82.9759666
7/16/02	1733 EST	6772A	ON	SI_FISH	24.5755666	82.9759666
7/16/02	1733 EST	6772A	ON	SI_FISH	24.5755666	82.9759666
7/16/02	2044 EST	6772A	ON	DIVE	24.5755666	82.9759666
7/16/02	2052 EST	6772A	ON	DIVE	24.5755666	82.9759666
7/17/02	1245 UTC	11460A	ON	SPORT	24.62058333	83.07995
7/17/02	1303 UTC	11460A	ON	SPORT	24.62141667	83.08888333
7/17/02	1350 UTC	12379	OS	SPORT	24.59518333	83.08201667

Date	*Start Time*	*Station*	*Strata*	*Sample Code*	*Latitude*	*Longitude*
7/17/02	1439 UTC	12379	OS	SPORT	24.59525	83.08386667
7/17/02	1511 UTC	12379	OS	SVHS/DV	24.59985	83.0892
7/17/02	1511 UTC	12379	OS	ASP	24.60004486	83.08913397
7/17/02	1540 UTC	12379	OS	SVHS/DV	24.59865	83.08671667
7/17/02	1540 UTC	12379	OS	ASP	24.59867936	83.08592189
7/17/02	1615 EST	2780	PS	DIVE	24.6733613	82.7809035
7/17/02	1622 EST	2780	PS	DIVE	24.6733613	82.7809035
7/17/02	1724 EST	2780	PS	DIVE (SEED)	24.6733613	82.7809035
7/17/02	2052 EST	2780	PS	DIVE	24.6733613	82.7809035
7/17/02	2042 EST	2780	PS	DIVE	24.6733613	82.7809035
7/17/02	1828 UTC	2780	PS	SPORT	24.6795	82.77055
7/17/02	1858 UTC	2780	PS	SPORT	24.66671667	82.77856667
7/18/02	0247 UTC	2780	PS	DROP	24.67779916	82.77731677
7/18/02	0247 UTC	2780	PS	ASP	24.67779916	82.77731677
7/18/02	0247 UTC	2780	PS	SVHS/DV	24.67779916	82.77731677
7/18/02	0256 UTC	2780	PS	DROP	24.67587198	82.77733176
7/18/02	0256 UTC	2780	PS	ASP	24.67587198	82.77733176
7/18/02	0256 UTC	2780	PS	SVHS/DV	24.67587198	82.77733176
7/18/02	0311 UTC	2780	PS	DROP	24.67759768	82.77934744
7/18/02	0311 UTC	2780	PS	ASP	24.67759768	82.77934744
7/18/02	0311 UTC	2780	PS	SVHS/DV	24.67759768	82.77934744
7/18/02	0328 UTC	2780	PS	DROP	24.6738717	82.78092156
7/18/02	0328 UTC	2780	PS	ASP	24.6738717	82.78092156
7/18/02	0328 UTC	2780	PS	SVHS/DV	24.6738717	82.78092156
7/18/02	0450 UTC	2780	PS	ROV	24.67429788	82.7774233
7/18/02	0450 UTC	2780	PS	ASP	24.67429788	82.7774233
7/18/02	0450 UTC	2780	PS	SVHS/DV	24.67429788	82.7774233
7/18/02	0830 EST	Monument Bank		TRUTH		
7/18/02	1322 EST	*Acropora* Patch		DIVE (TEMP)	24.62075703	82.86742017
7/18/02	1508 EST	White Shoal		DIVE	24.6423300	82.8968330
7/18/02	1753 EST	White Shoal		DIVE	24.6423300	82.8968330
7/18/02	2040 EST	White Shoal		DIVE	24.6423300	82.8968330
7/18/02	2222 EST	White Shoal		DIVE	24.6423300	82.8968330

APPENDIX III. Sample codes.

ASPEN FILE	ASP
drop camera	DROP
digital video	DV
ground truth point	TRUTH
light profile (stationary)	LGT_STAT
MiniBAT tow	BAT
ROV	ROV
seed cores	SEED
Sport Scan	SPORT
stable isotope (fish)	SI_FISH
Super VHS video	SVHS
temperature logger	TEMP

APPENDIX IV. Dive statistics.

Diver Name	*Date*	*% O2*	*Depth (ft)*	*Bottom Time (min)*
S Viehman	7/15/02	21	61	37
D Field	7/15/02	21	61	37
C Addison	7/15/02	21	59	39
W Figueira	7/15/02	21	59	39
E Eilers	7/15/02	21	60	34
C Slade	7/15/02	21	60	34
R Kelty	7/15/02	21	59	34
C Addison	7/15/02	21	55	40
W Figueira	7/15/02	21	55	40
S Viehman	7/15/02	21	60	40
D Field	7/15/02	21	60	40
G Piniak	7/16/02	21	55	40
R Kelty	7/16/02	21	55	40
S Viehman	7/16/02	21	59	44
C Slade	7/16/02	21	59	44
E Eilers	7/16/02	21	53	40
W Figueira	7/16/02	21	53	40
G Piniak	7/16/02	21	55	33
R Kelty	7/16/02	21	55	33
S Viehman	7/16/02	21	55	42
C Slade	7/16/02	21	55	42
C Addison	7/17/02	21	54	25
S Viehman	7/17/02	21	54	25
W Figueira	7/17/02	21	49	36
R Kelty	7/17/02	21	49	36
G Piniak	7/17/02	21	54	31
C Slade	7/17/02	21	56	31
D Field	7/17/02	21	56	31
W Figueira	7/17/02	21	52	48
R Kelty	7/17/02	21	52	48
C Addison	7/17/02	21	53	43
S Viehman	7/17/02	21	53	43
D Field	7/18/02	21	9	15
G Piniak	7/18/02	21	9	15
W Figueira	7/18/02	21	48	45
S Viehman	7/18/02	21	48	45
C Addison	7/18/02	21	45	42
R Kelty	7/18/02	21	48	42
C Slade	7/18/02	21	48	42
W Figueira	7/18/02	21	43	47
G Piniak	7/18/02	21	43	47
D Field	7/18/02	21	47	47
S Viehman	7/18/02	21	47	47
C Slade	7/18/02	21	44	44
R Kelty	7/18/02	21	44	44
C Addison	7/18/02	21	46	46
E Eilers	7/18/02	21	46	46